Fermi National Accelerator Laboratory

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Building a Productive Year-Round Teacher, Researcher, Student-Interaction

F. Markley and J. Mashek

Fermi National Accelerator Laboratory
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BUILDING A PRODUCTIVE YEAR-ROUND TEACHER, RESEARCHER, STUDENT INTERACTION

To better understand the interaction of the teacher, researcher, and student in this project, some background information should be helpful.

The researcher in this instance is Finley Markley, the director of the Materials Testing Laboratory at Fermi National Accelerator Laboratory (Fermilab). Through his efforts and pre-planning, useful and meaningful projects were designed for the other participants in this collaboration. All projects which were undertaken by the teacher and students were within the ability of those involved and sufficient assisistance was available to enable the participants to continue the project successfully.

The teacher in this collaboration is James Mashek, a physical science teacher from a small consolidated school district in Nebraska, Oakland-Craig Public School. Mr. Mashek has taught earth science, physical science, chemistry and physics in this school system for 26 years. The enrollment at this school is approximately 180 students, 7th through 12th grades. Mr. Mashek became involved with the Materials Testing Laboratory through a Department of Energy program called "TRAC" or Teacher Research Associates. This program provides teachers of science and mathematics an opportunity to experience the real world of research at Department of Energy research facilities throughout the United States.

The students in the collaboration come from the TARGET SCIENCE AND ENGINEERING program. Students in this program are minority students who come from the Chicago area and have expressed an interest in science and mathematics. One half of their day is spent at Fermilab where they are to have a work experience for which they are paid. The other half a day is spent at a local high school where the students spend time with a science project. The students are supervised by high school teachers, and their projects may involve electronics, physics, or biology.

In some laboratories, the TARGET student's work experience is one which is rather menial in nature. At the Material Testing Laboratory, the type of task assigned a student is beyond the "bolt sorting" category. Tasks are designed by Mr. Markley which are within the student's capability and staff has been assigned to assist the students with these tasks. The tasks are of such a nature that the data collected by the students is useful. That is to say, the data obtained will be used in an ongoing program at Fermilab, such as the SSC (Superconducting Super Collider) or the Fermilab Upgrade Project.

At this point I would like to relate personal experiences which may be helpful in explaining how a teacher from a small rural community in Nebraska can contribute to a research project of this magnitude. Upon being selected for this project, I recognized that I would not be expected to know everything about what was going on. When I first arrived at the Materials Testing Laboratory, I was given a careful overview of the projects which were ongoing in the laboratory.

My specific role the first summer I was at Fermilab was to design an apparatus which could be used to calibrate an extensometer at liquid helium temperatures. This was a challenging project for me because, at that time, no one at the lab was familiar with liquid helium, and so we all had to learn about it together. Another obstacle was the apparatus. It was to be designed by me and parts of it were to be fabricated by me.

I became discouraged by the thought of having to fabricate the device. I do not have much experience with machine tools and I became frustrated by the thought of having to work with them. Mr. Markley assured me that the major fabrication would be done by skilled machinists and that I would work on some parts of the apparatus under the supervision of a skilled machinist.

This episode occurred about eight days after I arrived at Fermilab and points out that it is easy to be overwelmed by the project due to lack of knowlege and experience. I feel tnat Mr. Markley was able to alleviate my apprehesions and give me encouragement.

Another factor which must be addressed is the full time staff. They are aware of the "summer people" and are very open and helpful when approached with questions. If it were not for their cooperation, very little could be accomplished by summer people whether it is finding a simple piece of wire to the operation of a computer system.

The working environment at the material testing lab is one which is foreign to a school teacher. It was pointed out to me many times that projects undertaken in a research and developement lab usually don't work out the first time. It is trial and error, and most of the time it's error. To someone who is not used to the constant road-blocks to progress, it can be very frustrating and discouraging. By the time I ended my first summer, I became accustomed to road-blocks and started to see them as challenges.

About the fourth week that I was at the Materials Testing Laboratory, three minority high school students from the Chicago area arrived. They were to be involved in a half-day work experience at the Materials Testing Laboratory and a half-day science investigation at a local high school supervised by local science teachers.

My job was to assist the students in the Materials Testing Lab to insure that they were functioning well with the task that they were assigned. I also needed to determine how they worked with the people to whom they were assigned. These students were from varying backgrounds and interests. Their adjustment to the tasks assigned could be difficult. The tasks that they were assigned were not mere make-work jobs, but research projects, the results of which would be used to make decisions about multi-million dollar projects.

My second summer at the Material Testing Laboratory was more enjoyable and interesting than the first. I was to complete the task that I was assigned the first summer, the liquid helium extensometer calibration apparatus, and I was also able to work on a new project. The new project was to assemble an apparatus which measures the thermal expansion properties of a series of related insulating materials which are to be used in the construction of massive magnet coils for the main injector ring of the proposed 3 Tev Collider.

The apparatus consists of an oven, which has a computer control unit which is able to control the rate at which the oven heats up, a dilatometer, which is composed of an outer pyrex tube in which the sample is placed, a thermocouple, to determine the temperature of the sample, a linear variable differential transducer (LVDT), to determine the change in length, and a X-Y chart recorder.

During this summer I again worked with students of the TARGET program. One student worked with me in the coefficient of thermal expansion experiment, while two other students worked together determining the index of refraction of samples of the same epoxy resins. The student that I was working with helped make samples for testing and was involved in the test of the material.

As the summer came to an end and I was preparing to return to my teaching assignment in Nebraska, Finley Markley asked if I would be interested in continuing the research that I had started that summer in my own community of Oakland, Nebraska. After obtaining permission from my superintendent, arrangements were made and the apparatus was shipped from Fermilab to Oakland. At Oakland, the apparatus was assembled and samples were tested.

I have involved several of my science students in this experiment. Some students are involved in the determining of the coefficient of thermal expansion, while others from the computer class are attempting to determine how to collect data directly from a computer link.

In an effort to develop a computer link-up for the experiment, I have contacted Ron Bonnstetter, the Science Methods Teacher from the University of Nebraska. He is assisting me by giving me access to his account in Bitnet, a computer network, which will allow me to communicate with Fermilab.

I have also contacted Dr. Guenther, the chairman of the Physics Department at the University of Nebraska at Omaha (UNO). Upon discussing my experiment with him, he gave me some ideas which may help me in collecting valid data.

I believe that the program in which I am participating has helped me grow professionally and has allowed me to become more aware of my potential as a scientist. There is a saying "Those who can, do. Those who can't, teach." I am a professional teacher, and everytime I hear this statement, I become angry.

I know what it is to be a teacher and I know the value that I have to the society in which I live. This program acknowledges that contribution. Part of my usefulness to the program I am in is because I am a teacher. Mr. Markley has said this to me many times and this is important to me. Knowing that I am capable of doing other things makes it easier for me to stay in teaching knowing that I could do other things. I can now answer such ridiculous comments made by critics of the teaching profession with the knowlege that "I can do, and choose to teach too."

In summary I would like to state that this program has many benefits to the participants.

First to the teacher who is involved in the program there is an opportunity to expand his background. He is allowed to develop a knowlege of what the real world of scientific investigation is all about and in doing so develop an improved self-concept.

Secondly, the students involved are exposed to practical scientific experiments, learning the scientific method in practice and not from some dry text book. The students also learn about responsibility. In this program, their work is valuable and their contribution therefore is valued. When a student's work and contribution has value, this student,s self-image will be improved. Exposure to a scientific environment will also foster the possibility of the student pursuing a career in science.

Lastly, the researcher is a benefactor of this program. If proper pre-planning is done, the students and teachers will contribute data from their efforts. The background of a teacher and a student is different than that of a researcher. They are able to learn from each other. One's prospective of the problem is expanded if different points of veiw are taken.

There are many other benefits that come about from this collaboration. The examples of the benefits that I have mentioned should give you some idea how it works and what can be accomplished by it when it does work.

Respectfully contributed by James E. Mashek, TRAC teacher, and Finley Markley, Supervisor, Materials Testing Laboratory, Fermilab.